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Inertial Fusion Energy Development at LLNL: the National Ignition Facility, 100-1000 TW Lasers, and Fast Ignitor Physics

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Topical Area: Laser Fusion

The goal of the National Ignition Facility (NIF) Project is to demonstrate ignition and propagating burn of fusion fuel in the laboratory. The NIF will use advanced glass laser technology to deliver 1.8 MJ of 0.35-micron laser light in a shaped pulse several nanoseconds in duration, achieving 500 TW of power. The laser is currently in the engineering design phase. A national community of U.S. laboratories is participating in the design, and will also participate in the construction and operation of the facility. The U.S. government also has bilateral agreements with France and the United Kingdom that involve collaborations with scientists from these countries on technologies underlying the NIF Project.

In this presentation we will discuss some details of the laser design activities. Laser components include the optical pulse generator, power amplifier, optical switch, diffractive optics, pulsed power system, laser diagnostics, laser alignment systems, optics cleaning systems, and control systems. We are learning how to produce, test and characterize large-aperture, high-quality optics in large quantities. These items include laser glass, KDP crystals, fused silica, and high damage threshold coatings.

In parallel to the NIF Project work, development work is proceeding on high-power, ultrashort pulse lasers to be used to explore an alternate ignition concept that has the potential to produce higher gains at a given drive energy than conventional laser fusion targets. The "Petawatt" (or 1000 TW) beamline will be available on Nova in the Fall of 1996. This beamline will provide 800 J of 1-micron light in a 0.6 ps duration pulse. This beamline will be able to produce focused intensities in excess of 10^21 W/cm^2 and will incorporate advanced adaptive optics. Its primary purpose will be to test technological and scientific aspects of the Fast Ignitor concept, where a high-intensity beam (~10^20 W/cm^2 in a 1-10 ps pulse) is used to heat a target that has been imploded by direct or indirect drive using the remaining laser beams. The physics issues to be addressed on

Nova, which we will discuss in this presentation, revolve around efficient laser-energy transport through the plasma surrounding the target core region, and efficient energy coupling to the dense fuel region.

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